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NOTES ON GALAPAGOS LEPIDOPTERA

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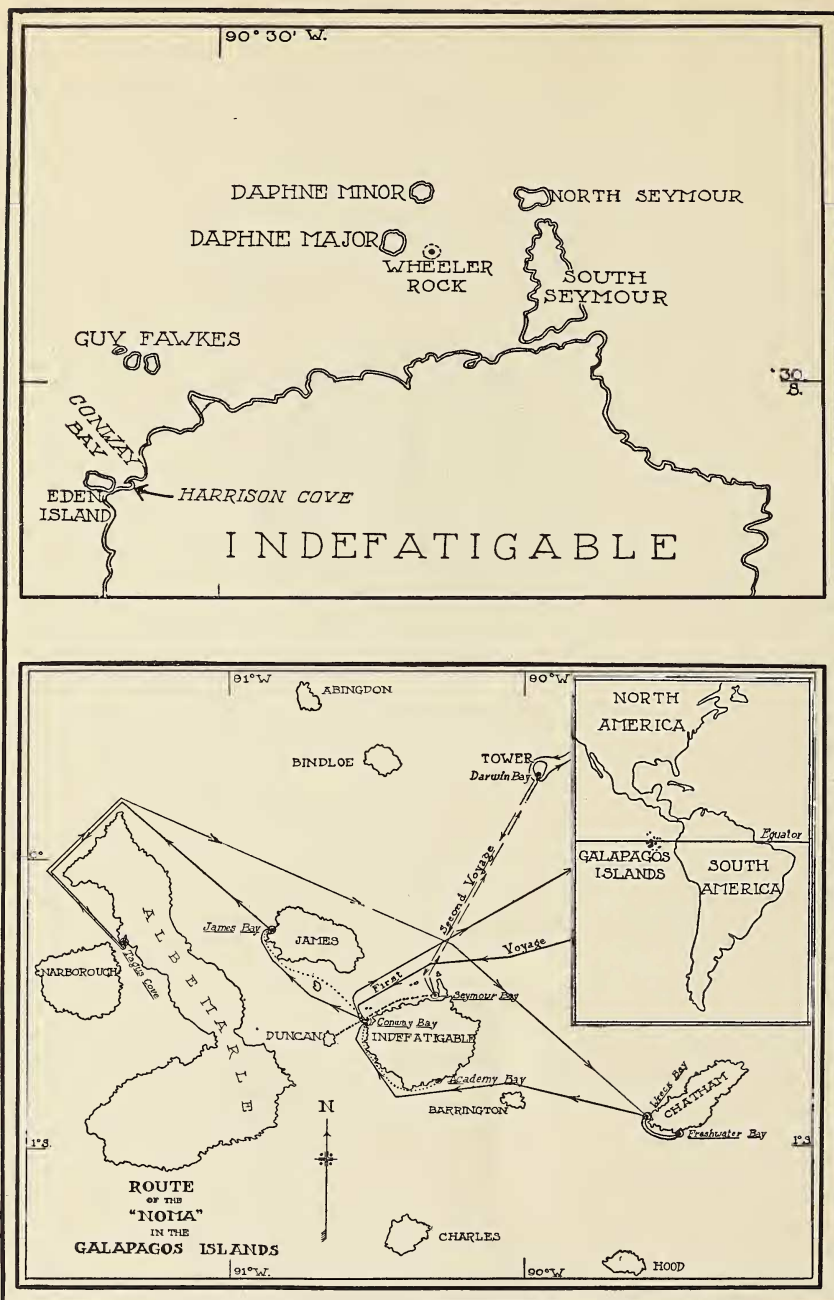


Plate A. SKETCH MAP OF GALAPAGOS ISLANDS
Route of the *Noma*, and details and location of the Archipelago.

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Suborder HETEROCERA

The contribution which the Williams Galapagos Expedition is able to make to our knowledge of the Heterocera or moths of the Galapagos Archipelago is of especial interest for several reasons, first, the unusual facility of collecting which made it possible to secure a large number of perfect specimens in the limited time available, and second, the almost absolute lack of published insular data on this group.

Nineteen years ago W. Warren described *Perixea impudens* from specimens collected by Beck on Gardner Island;¹ the following year he described *Sericosema lignata* from S. E. Albemarle,² and in 1911 in his report on the Expedition of the California Academy of Sciences, Francis X. Williams enumerated nine forms of Sphingidae, and casually mentioned the following six Heterocera of other families;³

Utehesia(sic) ornatrix
Erebus odora
Agrotis ypsilon
Meliopotis(sic) nigrescens
Meliopotis sinualis
Prodenia sp.

Although I was able to gather what seemed an unusually representative collection, yet only the first and fourth of the above

¹ Novitates Zoologicae, XI. 1904. p. 487.

² Ibid. XII. 1905. p. 362.

³ Proc. Cal. Acad. Sci. (4) I. 1911. p. 319.

list were obtained by me, a hint perhaps that some species are found only during other than the rainy season.

The admirable paper which Dr. Schaus has prepared on my collection deals with six hundred and twenty-six specimens, which prove to be divisible into fifty-two species. Of these, exactly one-half or fifty per cent are new to science, while only four of the remaining twenty-six species have ever been recorded from this archipelago before. The inclusion of the microlepidoptera increases the number of specimens to six hundred and sixty-four and the species to sixty-one.

While individual moths were taken on every possible occasion on shore, yet by far the greater number were collected on board our floating home, the steam yacht *Noma*. We had a very powerful searchlight on the forward upper deck, a light developing about five thousand candle power, and whenever we anchored off any island, after dark this light was turned toward the nearest shore. Even when a mile away, it was so powerful that with high-power glasses we could easily distinguish figures of our party, and even small shrubs on the beach.

Within ten minutes of the focussing of the mighty shaft of light, tiny motes would become visible far down the luminous path, looking like moving flecks of gold, and in a remarkably short time the first moths would appear. Their behavior was identical, regardless of time of night, location or species. For a short time they would flutter about the glass in the full glare, and would then alight on the nearest white surface. On deck this would be the under side of the awnings, which soon were covered with a host of the little organisms. When the searchlight was turned off, the moths gradually sought other lights, the favorite being the brilliant electric glow by which we worked in the laboratory. This was the metamorphosed sun-parlor, which, painted white and with large windows opening on all sides, proved a veritable Mecca for moths. On some nights we had almost to stop work, such was the mass of insects which boarded the vessel. They clung in dense clusters about the globes, they covered the ceiling and walls, and so omnipresent were the scales from the tiny wings that any delicate microscopic work was almost impossible,

On the whole the nightly assemblage was a pure culture of moths, but there was sometimes a scattering of other insects, such as the following:

Giant female yellow and red locusts, *Schistocera melanocera* (Stål).

Large metallic green ground beetles, *Calosoma howardi* Linné.
(Especially at James Island.)

A single giant brown longicorn, *Mallodon molarium* Bates.

Small black Hemiptera, Lygaeidae

Green squash Bugs, Pentatomidae

Minute green Hemiptera, Miridae (Capsidae)

Flying ants, *Camponotus planus* var. *peregrinus* Emery and
var. *isabelensis* Wheeler (mss.).

Only when the wind blew very strongly off shore did any mosquitoes come on board; the moths were as abundant in a cross or even adverse wind, but on evenings of dead calm, few insects of any kind appeared.

On April 19th we were anchored two and a half miles west of South Seymour, off the northeast coast of Indefatigable. Several showers fell during the day, and in the evening we had an unusually large visitation of moths. The dominant species was *Eromene ocella* Haworth, which I had also found common at Conway Bay. They were beautiful little creatures, fawn-colored with two orange-buff bands across the wings, and at the wing-tips was a line of silver gilt enamel drops. The yacht was inundated with them. At ten o'clock I counted seven hundred on the walls of the laboratory alone. Half an hour later there were more than twenty-five hundred on the forward awning, and on the other awnings, and boats, in cabins, smoking-, chart-, and dining-rooms there could hardly have been less than twenty or twenty-five thousand of these little exquisites, averaging about three-fourths of an inch across the wings, which had flown over two and a half miles to the source of the magnetic light. The second species in abundance was *Atteva hyssiniella* Wallengren. This was also less than an inch in extent, but by far the gayest lepidopteran of the whole archipelago. Its fore wings were of a brilliant, metallic, bottle green, with purple reflections, marked with bold lines of pale yellow, and six burning spots of orange gold. There were several thousand on board, and they were conspicuous not only in pattern and pigment, but in the position which they maintained when resting. They stood high on

four legs, with the long antennae raised as high as possible, and the tip of the abdomen lowered so that it touched the surface of the wall. To a casual glance they looked much more like a beetle or a hemipter than a moth. Third in numbers was a new species, *Amyna insularum* Schaus, which at Conway Bay on the northwest coast of Indefatigable was always the most abundant, heading the list both on clear and cloudy evenings. They were dark bronzy brown with indistinct, wavy markings of black. At rest, the wings were flattened and extended backward, so that the insect was triangular in shape.

On the whole the moths which came to our lights were sombre in color, and small in size, although *Melipotis nigrescens* expands two inches, and *Beebea guglielmi* reaches two and a quarter inches.

As to the origin of this fauna I shall have more to say in another paper, but here I will mention that of all the non-autochthonous species, not one is exclusively confined to the South American continent, but all range as far north as Costa Rica, and some even to the United States, while a considerable number are altogether Central American.

Walking through the undergrowth or short grassy plants on shore, small moths continually flew up from one's path, but the species more particularly diurnal and active even at high noon in brilliant sunshine were the bright-colored *Atteva hyssiniella* and *Eromene ocella*. These haunted the yellow flowers of *Cordia*, *Cassia* and *Gossypium* in large numbers, in common with a butterfly, *Callidryas eubule*, a beetle, *Oxaxis*, and a green-winged hemirobiid.

As to the relations between Heterocera and other members of the Galapagos fauna, the smaller species of moths are frequently devoured by purple martins, flycatchers and mockingbirds, and less often by *Tropidurus* lizards (four records), and the common snake *Dromicus dorsalis* (one record).

Family SPHINGIDAE

To continue the enumeration of the Heterocera of the Galapagos, Williams, as I have said, has recorded nine forms of sphinx moths from this archipelago. Of these I obtained only four;

62 *Deilephila lineata* Fab.

3—South Seymour.

63 *Dilophonota obscura conformis* Roth. & Jordan.

2—South Seymour, Conway Bay.

64 *Phlegathontius galapagensis nigrita* Roth. & Jordan.

1—South Seymour, Tagus Cove.

65 *Herse cingulata* Mer.

1—South Seymour.

Only *conformis* and *cingulata* ever flew on board at night to the light and that very rarely. The white-lined sphinx, *Deilephila lineata*, was decidedly diurnal, and all day in the brightest sunshine it could be found hovering before small blossoms. Twice, on South Seymour, I saw purple martins pursuing and catching and feeding upon this hawk moth. I obtained many specimens of *nigrita* from cobwebs on Indefatigable and Albemarle, as well as other unidentifiable species. Every morning there would be a new lot, visible as oblong, web-swathed moth mummies, apparently suspended in space between the bushes.

Suborder RHOPALOCERA

Six species of butterflies have been recorded from the Galapagos. Four of these I found to be common almost everywhere I explored.

1—*Callidryas eubule* Linné.

New localities,—Eden, Daphne, South Seymour.

2—*Agraulis vanillae galapagensis* Holland.

New localities,—Eden, South Seymour.

3—*Cupido parrhasionides* Wallen.

New localities,—Indefatigable, Eden, South Seymour.

4—*Eudamus galapagensis* Williams.

New localities for specimens,—Indefatigable, James, Eden, South Seymour.

I can add one new species to the Galapagos fauna,

5—*Danaüs plexippus* (Linné)

On April 7th two of these unmistakably familiar butterflies flew slowly about us near the shore at Freshwater Bay, on the south side of Chatham, when we were siphoning off a boatload of water. Three of us saw the insects, but we had no opportunity of capturing them.

Two phases of butterfly life in the Galapagos seem worthy of record,—the butterfly diet of some of the birds, and the migration of *Callidryas eubule*.

My first hint of the lepidopterophagus habits of the birds of

these islands was on the small island of Eden off the northwest coast of Indefatigable. I had been interested in watching a half dozen nests of the Galapagos purple martin, *Progne modesta*, when a yellow butterfly, *Callidryas eubule*, fluttered slowly down over the cliff toward us, and at once a martin set off in pursuit. It was a long zigzag chase with the "sulphur" trying to dodge, now down to the water, back to shore, and around in spirals,—a veritable whirling bit of yellow tissue. At last an unlucky turn fairly shot the insect into the mouth of the martin and the bird flew about for a full minute before the wings disappeared, either dropped to the ground or swallowed.

Urged by Professor Poulton, I have for many years kept on the watch for instances of birds attacking butterflies, as considerable weight of certain mimicry and color theories depends upon butterflies having aerial enemies. That lizards often devour these insects is well known, but a bird as assailant is a rarer event. In Ceylon and in Burma, in the high Himalayas, and in central China I have occasionally seen such pursuits, but they were seldom successful, and often appeared to be mere half-hearted, sporting activities, a pitting of wing power against a worthy opponent, as birds will pursue each other in mid-air. I have seen many thousands of opportunities neglected, where migrating butterflies were passing scores to the second in sight, with flycatchers and swallows hawking about, wholly indifferent to this abundant but fuzzy source of food.

Seventeen years ago E. W. Gifford⁴ made four notes on this subject, writing of the martins of Tagus Cove, Albemarle. He says,—

"I saw one with a butterfly in its mouth being pursued by two others."

"I saw one enter its nest with a medium sized yellow butterfly in its mouth."

"I saw one make a dozen or so unsuccessful attempts to catch a yellow butterfly which was crossing the cove."

"On April ninth, I noted one chasing a sphinx moth over Tagus Cove; the moth finally dropped into the water and the bird left it."

Stimulated by the observation which I had made so early in my visit to the islands, I kept on the watch, and for the first time

⁴ Proc. Cal. Acad. Sci. (4) Vol. II, No. 13, 1919, pp. 206-207.

in my life I found aerial birds which fed largely on butterflies and moths. Within five minutes after my first martin-butterfly incident, I saw two others chasing a red butterfly which they failed to capture. The first butterfly and at least two of those mentioned by Gifford were *Callidryas eubule*, almost identical with our northern forms, and the reddish one was the fritillary, *Agraulis vanillae galapagensis*. During the ensuing twenty days which I spent on the islands I made notes of thirteen additional instances of the same character, twelve of the victims of which were *Callidryas*, and the other one *Agraulis*.

Not only this, but when I returned to the Noma from the first trip to Eden and examined the food of the martins I had taken, I found that both the young fledgling and its male parent had been feeding almost entirely upon small moths. Two wings of a larger specimen were still recognizable as a new species of moth, *Melipotis harrisoni* Schaus. The nestling had been fed twelve, and the parent had himself eaten at least twenty-one moths,—all small, all dull in color. At another island, South Seymour, as I have already mentioned, I saw the same species of bird pursuing and feeding on a small diurnal sphinx moth, *Deilephila lineata*.

It is a usual thing for cuckoos of various species to feed upon hairy caterpillars and other unpleasant-appearing provender, but it is not common for diurnal birds to be willing to devour such fuzzy creatures as are these millers. I remember in Garhwal, high up in the Himalayas, half round the world, I have shot white-crested kaleege pheasants with their crops stuffed with two or three dozen small moths, all swallowed whole and quite identifiable. Both the mockingbirds and flycatchers of the Galapagos were expert and willing butterfly catchers. All this is in very decided contrast to what obtains elsewhere, for in my experience, the relation between birds and butterflies is quite a negligible factor in any lepidopterous theory of evolution of pattern, color, form or activity. With fat, winged and wingless grasshoppers of all sizes so abundant everywhere in these islands, the diet of butterflies became all the more inexplicable.

On April 23rd I left the yacht and took a motorboat five miles to Daphne Major, off the northeast coast of Indefatigable. When halfway to the island *Callidryas eubule* began to pass us, and recalled that on three previous days and once on my first voyage to the archipelago I had observed a similar migration. It is a common

but mysterious habit in mainland representatives of closely related forms, and in British Guiana often takes place on an extraordinary scale.⁵

There, the usual direction was north-northwest; here it seemed invariably southeast. On Indefatigable I watched it two days in succession, the insects flying low over the water from the direction of James and Albemarle and continuing due southeast across cactus and craters. Again on the backbone of Seymour I saw many keeping on their course straight out to sea in the teeth of the trades, headed for Chatham, and finally in Freshwater Bay on the south shore of Chatham, brave little "sulphurs" were fluttering past on their inexplicable compass-true path headed for the open sea and certain death. Yet all around were others flying from cotton-blossom to the blooms of the *Cordia*,—each as yellow as their own wings,—paying no heed to their travel-stricken fellows in mid-air. Soon, perhaps, they in their turn would follow. The Galapagos martin has abandoned all his migrations, the sulphur butterflies of these islands are still slaves to an instinct which seems to us unreasonable, useless, almost inimical.

One other interesting butterfly migration was observed in the Galapagos, when we were at anchor in James Bay. On shore *Agraulis* was about as abundant as the black skippers, *Eudamus galapagensis*, and both were living in the same high, open, weedy places at the base of the mountain. When on shore I saw no signs of a concerted movement among any of the species, the *Agraulis* flying slowly from flower to flower, or resting on leaves, waving their wings in the sun.

About seven o'clock in the morning of April 5th a strong migration of the *Agraulis* began, visible from the deck of the Noma, two miles off shore. As far as my eyes or my glasses could reach in all directions, the red and black butterflies were seen flying steadily and quite rapidly from southeast to northwest,—in exactly the opposite direction from that which the migrating *Callidryas* took near Indefatigable. Although these butterflies flew well apart, I counted three hundred and sixteen within a short time, and caught six on deck. After breakfast, and later when we left at nine o'clock, the migration was going on as strongly as ever. If maintained, this line of flight would carry the insects parallel to Albe-

⁵ Edge of the Jungle, 1921, pp. 259-263,

marle, out into the open Pacific, with only the tiny specks of Culpepper and Wenman far to the northwest, islets from which this species of butterfly has never been recorded.

Whenever there is variation of Galapagos lepidoptera from closely related mainland forms, it is usually in the direction of a reduction in size and a darkening or melanism of the colors in general. This is especially noticeable in the white-lined sphinx *Deilephila lineata*, and in *Agraulis galapagensis*. Unless the coastal stock is constantly derived and replenished from the more humid zone of the interior of the islands, it is difficult to account for the darkening of specimens, the entire coastal zone being semi-arid. The reduction in size may be due to insufficient nourishment on the part of the caterpillars, for except at the height of the brief rainy season they must often be hard put to it to find sufficient green leaves for food.

This is one of the series of scientific papers of the Harrison Williams Galapagos Expedition, under the directorship of William Beebe, sent out by the Department of Tropical Research of the New York Zoological Society. The general account and narrative of the expedition, together with the natural history and photographs of the fauna, are embodied in a volume by William Beebe, published by G. P. Putnam's Sons, under the auspices of the Zoological Society. Its title is "Galapagos; World's End."